

WHAT IS CLAIMED IS:

1. A NOx sensor comprising:
 a gas detection chamber composed of an internal
 space surrounded by zirconia solid electrolyte
 substrates having oxygen ion conductivity;
 a NOx sensing cell including a NOx sensing
 electrode fixed onto said zirconia solid electrolyte
 substrate in said gas detection chamber, said NOx sensing
 electrode being active to NOx and oxygen, and a reference
 electrode fixed onto said zirconia solid electrolyte
 substrate, said reference electrode being active to at
 least oxygen;
 a NOx conversion pumping cell including a NOx
 conversion electrode fixed onto said zirconia solid
 electrolyte substrate in said gas detection chamber, said
 NOx conversion electrode being active to NOx and oxygen,
 and a counter electrode to be paired with said NOx
 conversion electrode, said counter electrode being fixed
 onto said zirconia solid electrolyte substrate, being
 active to oxygen;
 voltage applying means for applying a
 predetermined voltage to said NOx conversion pumping
 cell;
 a first gas treatment chamber communicating with
 said gas detection chamber and having a gas inlet leading
 to an atmosphere of a gas to be detected, an inorganic

porous member being loaded into said first gas treatment chamber; and

means for measuring a potential difference between said NOx sensing electrode and said reference electrode while converting NOx in the gas to be detected into single component after a reducing gas in the gas to be detected is oxidized in said first gas treatment chamber, and thereby detecting a total NOx concentration in the gas to be detected.

10

2. The NOx sensor according to claim 1, wherein an electrochemical oxygen pumping cell [(oxygen supplying pumping cell)] for supplying oxygen to at least said first gas treatment chamber is arranged between said first gas treatment chamber loaded with said porous member and said gas detection chamber containing said NOx detection cell.

15

3. The NOx sensor according to claim 2, wherein said oxygen supplying pumping cell for supplying oxygen to at least said first gas treatment chamber is arranged in a second gas treatment chamber communicating with said first gas treatment chamber and said gas detection chamber.

20

4. The NOx sensor according to claim 1, wherein said first gas treatment chamber is formed across one of said zirconia solid electrolyte substrates surrounding

25

FIG. 7

said gas detection chamber, or said gas detection chamber
and second gas treatment chamber, and communicates with
said gas detection chamber or said second gas treatment
chamber through a gas diffusion hole or a porous member
5 arranged in said zirconia solid electrolyte substrate.

5. The NOx sensor according to claim 1, wherein
said porous member loaded into said first gas treatment
chamber has a porosity of 5-40%.

10

6. The NOx sensor according to claim 1, wherein
said porous member loaded into said first gas treatment
chamber comprises chiefly at least one selected from the
group consisting of zeolite, zirconia, alumina, and
15 silica, and/or a compound thereof.

7. The NOx sensor according to claim 1, wherein
said porous member loaded into said first gas treatment
chamber carries catalytic oxide and/or precious metal.

20

8. The NOx sensor according to claim 7, wherein
said catalytic oxide comprises ceria or a solid solution
of ceria and zirconia.

25

9. The NOx sensor according to claim 7, wherein
said catalytic precious metal ^{to be} carried by said porous
member loaded into said first gas treatment chamber

comprises one selected from the group consisting of Pt, Pd, Ir, Au, Ru, Ag, Rh, and a mixture thereof.

10. The NOx sensor according to claim 7, wherein
5 the amount of said catalytic precious metal to be carried by said porous member loaded into said first gas treatment chamber falls within the range of 0.1 and 30 mg/cm³ with respect to a bulk volume of said porous member.

10 11. The NOx sensor according to claim 1, further comprising:

an oxidation catalyst pumping cell including an oxidation catalyst electrode composed of said inorganic porous member loaded into said first gas treatment
15 chamber, said oxidation catalyst electrode serving as an anode electrode, and a cathode electrode to be paired with said oxidation catalyst electrode, said cathode electrode being arranged on a zirconia solid electrolyte substrate outside said gas detection chamber and being
20 active to oxygen; and

voltage applying means for applying a predetermined voltage to said oxidation catalyst pumping cell.

25 12. The NOx sensor according to claim 2, wherein said anode electrode of said oxygen supplying pumping cell is an oxidation catalyst electrode active to the gas

202507041800

25 17. The NOx sensor according to claim 16, further
comprising means³⁷ for measuring a potential difference
between said cathode electrode¹⁷ of said oxidation catalyst

pumping cell exposed to the gas to be detected and said reference electrode of said NOx detection cell or said counter electrode of said NOx conversion pumping cell communicating with an atmospheric air.

5

18. The NOx sensor according to claim 11, wherein at least one gas inlet is formed in the top or bottom of said first gas treatment chamber.

10

19. A NOx sensor comprising:

a gas detection chamber composed of an internal space surrounded by zirconia solid electrolyte substrates having oxygen ion conductivity;

15 a NOx detection cell including a NOx sensing electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx sensing electrode being active to NOx and oxygen, and a reference electrode fixed onto said zirconia solid electrolyte substrate, said reference electrode being active to at
20 least oxygen;

a NOx conversion pumping cell including a NOx conversion electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx conversion electrode being active to NOx and oxygen,
25 and a counter electrode to be paired with said NOx conversion electrode, said counter electrode being fixed onto said zirconia solid electrolyte substrate, being

100250-0124880

voltage applying means for applying a predetermined voltage to said NOx conversion pumping cell;

an oxidation catalyst pumping cell including an oxidation catalyst electrode arranged in said first gas treatment chamber, said oxidation catalyst electrode having a gas channel, being active to a reducing gas and oxygen, and serving as an anode electrode, and a cathode electrode to be paired with said oxidation catalyst electrode, said cathode electrode being arranged on a zirconia solid electrolyte substrate outside said gas detection chamber and being active to oxygen;

voltage applying means for applying a predetermined voltage to said oxidation catalyst pumping cell; and

20 means for measuring a potential difference between
said NOx sensing electrode and said reference electrode
while converting NOx in the gas to be detected into NO₂
or NO after the reducing gas in the gas to be detected
is oxidized in said first gas treatment chamber, and
25 thereby detecting the total NOx concentration in the gas
to be detected.

20. The NOx sensor according to claim 19, wherein said gas channel arranged in said first treatment chamber is composed of at least one narrow path arranged along the direction of flow of the gas to be detected.

5

21. The NOx sensor according to claim 20, wherein a diffusion resistance defined by the ratio (S/L) of the total cross-sectional area S of said path to the length L of said path falls within the range of 0.001 and 0.1.

10

22. The NOx sensor according to claim 1, wherein said reference electrode of said NOx detection cell is installed in said gas detection chamber.

NA, stated as "NOx sensing cell" in claim 1

15

23. The NOx sensor according to claim 1, comprising:

said reference electrode of said NOx detection cell being installed across said zirconia solid electrolyte substrate constituting said gas detection chamber, in a duct leading only to the air outside of said gas detection chamber;

20

an oxygen sensing electrode arranged in said detection chamber, said oxygen sensing electrode being active to oxygen alone; and

25

means for detecting the total NOx concentration while correcting the same for a potential difference between said reference electrode and said NOx sensing

100250-012200

Fig 3

electrode and a potential difference between said reference electrode and said oxygen sensing electrode.

24. The NOx sensor according to claim 1, wherein
5 said gas inlet arranged in said first gas treatment
chamber is covered with a porous protective film.

[illegible]